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BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

Application Number: 09/978,275
Filing Date: October 17, 2001
Appellant(s): YAMADA, MASAHIKO

Bhaskar Kakarla
For Appellant

EXAMINER'S ANSWER

This is in response to the appeal brief filed September 6, 2006 appealing from the Office action mailed October 6, 2005.

(1) Real Party in Interest

A statement identifying by name the real party in interest is contained in the brief.

(2) Related Appeals and Interferences

The examiner is not aware of any related appeals, interferences, or judicial proceedings which will directly affect or be directly affected by or have a bearing on the Board's decision in the pending appeal.

(3) Status of Claims

The statement of the status of claims contained in the brief is correct.

(4) Status of Amendments After Final

The appellant's statement of the status of amendments after final rejection contained in the brief is incorrect.

The amendment after final rejection filed on April 6, 2006 has not been entered.

(5) Summary of Claimed Subject Matter

The summary of claimed subject matter contained in the brief is correct.

(6) Grounds of Rejection to be Reviewed on Appeal

The appellant's statement of the grounds of rejection to be reviewed on appeal is correct.

(7) Claims Appendix

The copy of the appealed claims contained in the Appendix to the brief is correct.

(8) Evidence Relied Upon

No evidence is relied upon by the examiner in the rejection of the claims under appeal.

(9) Grounds of Rejection

The following ground(s) of rejection are applicable to the appealed claims:

Claims 1-3, 7-13, 20, 21 and 37-41 are rejected under 35 U.S.C. 102(b) as being anticipated by USPN 5,461,655 to Vuylsteke et al. (a reference of record, hereafter referred to as "Vuylsteke").

Regarding claim 1, Vuylsteke discloses an apparatus for suppressing noise in an input image signal representing a radiographic image (col. 1, lines 6-10), comprising:

a smoothing unit which processes said input image signal by using a smoothing filter so as to smooth said radiographic image (col. 6, lines 4-7; col. 3, line 61 – col. 4, line 17, lines 23-46, Vuylsteke teaches a noise reduction unit that performs smoothing at different resolution levels and reconstructs a processed image from the attenuated detail transform images.); and

a characteristic calculation unit which obtains at least one first characteristic of said input image signal by calculation using a function based on information indicating an exposure dose with which said radiographic image has been produced (col. 1, lines 14-18; col. 8, lines 39-67, Vuylsteke teaches the local variance of pixels and noise variance are computed for the image and that there is a well known tradeoff between image quality and patient dose due to the presence of noise in the radiation source. As described in the specification (page 7, line 20 – page 8, line 3) pixel values of the radiographic image are information that can indicate exposure dose. The variances described by Vuylsteke are characteristics of the image and are functions of pixel values that are indicative of exposure dose.);

said smoothing unit adapts at least one second characteristic of the smoothing filter to said input image signal based on said at least one first characteristic (col. 9, lines 42-58, Equation 1, Vuylsteke teaches the noise suppression function is based on the calculated variances.).

Regarding claim 2, Vuylsteke further discloses a band-limited image-signal generation unit which generates a plurality of band limited image signals respectively representing a plurality of band-limited images belonging to a plurality of different frequency bands base on said input image signal (col. 7, lines 9-13, 37- col. 8, line 3, Vuylsteke teaches a decomposition unit which applies a low pass filter to the input image to create a plurality of detail images.);

said smoothing unit processes said plurality of band-limited image signals by using said smoothing filter so as to smooth each of said plurality of band-limited images (col. 8, lines 22-26; col. 10, lines 4-6, Vuylsteke teaches noise reduction process repeated for all detail images.).

Regarding claim 3, Vuylsteke further discloses said band-limited-image-signal generation unit generates said plurality of band-limited image signals by performing multiresolution decomposition of said input image (col. 7, lines 9-13, Vuylsteke teaches the original image is decomposed into a sequence of detail images, which represent the amount of detail present in the original image at multiple resolution levels.).

Regarding claim 7, Vuylsteke discloses a method for suppressing noise in an input image signal representing a radiographic image (col. 1, lines 6-10), said method comprising the steps of:

(a) obtaining at least one first characteristic of said input image signal by calculation using a function based on information indicating an exposure dose with which said radiographic image has been produced (col. 1, lines 14-18; col. 8, lines 39-67, Vuylsteke teaches the local

variance of pixels and noise variance are computed for the image and that there is a well known tradeoff between image quality and patient dose due to the presence of noise in the radiation source. As described in the specification (page 7, line 20 – page 8, line 3) pixel values of the radiographic image are information that can indicate exposure dose. The variances described by Vuylsteke are characteristics of the image and are functions of pixel values that are indicative of exposure dose.);

(b) adapting at least one second characteristic of a smoothing filter to said input image signal based on said at least one first characteristic (col. 9, lines 42-58, Equation 1, Vuylsteke teaches the noise suppression function is based on the calculated variances.); and

(c) processing said input image signal by using said smoothing filter so as to smooth said radiographic image (col. 6, lines 4-7; col. 3, line 61 – col. 4, line 17, lines 23-46, Vuylsteke teaches a performing smoothing at different resolution levels and reconstructing a processed image from the attenuated detail transform images.).

Regarding claim 8, Vuylsteke does not explicitly recite "a computer-readable storage medium storing a program which instructs a computer to execute a method." The apparatus Vuylsteke describes clearly performs computations on digital pixel values, has memory and can output a viewable image on a display screen (CRT) (col. 6, lines 1-13). This description of the processing apparatus clearly describes the elements and capabilities of a conventional computer, which inherently have computer-readable storage mediums (including, but not limited to RAM, ROM, Hard drives) in which programs are stored for execution by the computer.

Vuylsteke further discloses a method for suppressing noise in an input image signal representing a radiographic image (col. 1, lines 6-10), said method comprising the steps of:

(a) obtaining at least one first characteristic of said input image signal by calculation using a function based on information indicating an exposure dose with which said radiographic image has been produced (col. 1, lines 14-18; col. 8, lines 39-67, Vuylsteke teaches the local variance of pixels and noise variance are computed for the image and that there is a well known tradeoff between image quality and patient dose due to the presence of noise in the radiation source. As described in the specification (page 7, line 20 – page 8, line 3) pixel values of the radiographic image are information that can indicate exposure dose. The variances described by Vuylsteke are characteristics of the image and are functions of pixel values that are indicative of exposure dose.);

(b) adapting at least one second characteristic of a smoothing filter to said input image signal based on said at least one first characteristic (col. 9, lines 42-58, Equation 1, Vuylsteke teaches the noise suppression function is based on the calculated variances.); and

(c) processing said input image signal by using said smoothing filter so as to smooth said radiographic image (col. 6, lines 4-7; col. 3, line 61 – col. 4, line 17, lines 23-46, Vuylsteke teaches a performing smoothing at different resolution levels and reconstructing a processed image from the attenuated detail transform images.).

Regarding claim 9, Vuylsteke discloses a method for suppressing noise in an input image signal representing a radiographic image (col. 1, lines 6-10), said method comprising the steps of:

(a) generating a plurality of band-limited image signals respectively representing a plurality of band-limited images belonging to a plurality of different frequency bands, based on said image signal (col. 7, lines 9-13, 37- col. 8, line 3, Vuylsteke teaches a decomposing the

input image using low pass filtering to create a plurality of detail images representing multiple resolution levels.);

(b) obtaining at least one first characteristic of said input image signal by calculation using a function based on information indicating an exposure dose with which said radiographic image has been produced (col. 1, lines 14-18; col. 8, lines 39-67, Vuylsteke teaches the local variance of pixels and noise variance are computed for the image and that there is a well known tradeoff between image quality and patient dose due to the presence of noise in the radiation source. As described in the specification (page 7, line 20 – page 8, line 3) pixel values of the radiographic image are information that can indicate exposure dose. The variances described by Vuylsteke are characteristics of the image and are functions of pixel values that are indicative of exposure dose.);

(c) adapting at least one second characteristic of a smoothing filter to said input image signal based on said at least one first characteristic (col. 9, lines 42-58, Equation 1, Vuylsteke teaches the noise suppression function is based on the calculated variances.); and

(d) processing said plurality of band-limited image signals by using said smoothing filter so as to smooth each of said plurality of band-limited images (col. 6, lines 4-7; col. 3, line 61 – col. 4, line 17, lines 23-46, Vuylsteke teaches a performing smoothing on the different resolution level images.).

Regarding claim 10, Vuylsteke does not explicitly recite "a computer-readable storage medium storing a program which instructs a computer to execute a method." The apparatus Vuylsteke describes clearly performs computations on digital pixel values, has memory and can output a viewable image on a display screen (CRT) (col. 6, lines 1-13). This description of the

processing apparatus clearly describes the elements and capabilities of a conventional computer, which inherently have computer-readable storage mediums (including, but not limited to RAM, ROM, Hard drives) in which programs are stored for execution by the computer.

Vuylsteke further discloses a method for suppressing noise in an input image signal representing a radiographic image (col. 1, lines 6-10), said method comprising the steps of:

(a) generating a plurality of band-limited image signals respectively representing a plurality of band-limited images belonging to a plurality of different frequency bands, based on said image signal (col. 7, lines 9-13, 37- col. 8, line 3, Vuylsteke teaches a decomposing the input image using low pass filtering to create a plurality of detail images representing multiple resolution levels.);

(b) obtaining at least one first characteristic of said input image signal by calculation using a function based on information indicating an exposure dose with which said radiographic image has been produced (col. 1, lines 14-18; col. 8, lines 39-67, Vuylsteke teaches the local variance of pixels and noise variance are computed for the image and that there is a well known tradeoff between image quality and patient dose due to the presence of noise in the radiation source. As described in the specification (page 7, line 20 – page 8, line 3) pixel values of the radiographic image are information that can indicate exposure dose. The variances described by Vuylsteke are characteristics of the image and are functions of pixel values that are indicative of exposure dose.);

(c) adapting at least one second characteristic of a smoothing filter to said input image signal based on said at least one first characteristic (col. 9, lines 42-58, Equation 1, Vuylsteke teaches the noise suppression function is based on the calculated variances.); and

(d) processing said plurality of band-limited image signals by using said smoothing filter so as to smooth each of said plurality of band-limited images (col. 6, lines 4-7; col. 3, line 61 – col. 4, line 17, lines 23-46, Vuylsteke teaches a performing smoothing on the different resolution level images.).

Regarding claim 11, Vuylsteke discloses an apparatus for suppressing noise in an input image signal representing a radiographic image (col. 1, lines 6-10), comprising:

A band-limited-image-signal generation unit which generates a plurality of band-limited image signals respectively representing a plurality of band-limited images belonging to a plurality of different frequency bands, based on said input image signal (col. 7, lines 9-13, 37-col. 8, line 3, Vuylsteke teaches a decomposition unit which applies a low pass filter to the input image to create a plurality of detail images.);

An index-value obtaining unit which obtains at least one index value indicating a degree of suppression of said noise (col. 9, lines 42-58, Vuylsteke teaches the noise suppression function Sv_n.), the at least one index value corresponding to a function based on information indicating an exposure dose with which said radiographic image has been produced (col. 9, lines 42-58; col. 1, lines 14-18; col. 8, lines 39-67, Vuylsteke teaches the noise suppression function is a function of local variance. Vuylsteke teaches the local variance of pixels and noise variance are computed for the image and that there is a well-known tradeoff between image quality and patient dose due to the presence of noise in the radiation source. As described in the specification (page 7, line 20 – page 8, line 3) pixel values of the radiographic image are information that can indicate exposure dose. The variances described by Vuylsteke are characteristics of the image and are functions of pixel values that are indicative of exposure dose.); and

A noise suppression unit which processes each of said plurality of band-limited image signals so as to suppress noise in each of said plurality of band-limited images based on said at least one index value (col. 6, lines 4-7; col. 3, line 61 – col. 4, line 17, lines 23-46; col. 10, lines 4-6, Vuylsteke teaches a performing smoothing/noise suppression on the different resolution level images.).

Regarding claim 12, Vuylsteke further discloses wherein said index-value obtaining unit obtains said at least one index value indicating the degree of suppression of the noise for each of said plurality of band-limited image signals (col. 8, line 39-col. 4, lines 58, Vuylsteke teaches the variances are calculated from the detail images obtained from the decomposition stage and computing the noise suppression function based on the variances.), and

said noise suppression unit processes each of said plurality of band-limited image signals so as to suppress the noise in each of said plurality of band-limited images based on said at least one index value obtained for each of said plurality of band-limited image signals (col. 9, line 59 col. 10, line 8, Vuylsteke teaches the noise suppression process is repeated for all detail images.).

Regarding claim 13, Vuylsteke further discloses wherein said index-value obtaining unit obtains said at least one index value indicating the degree of suppression of the noise for each pixel of each of said plurality of band-limited images (col. 9, line 63 – col. 10, line 3, Vuylsteke teaches all variance pixels corresponding to the same level are fetched from memory and transformed into a sequence of attenuation coefficients, then pixelwise multiplied with pixels of the detail image at the same level.), and

Said noise suppression unit processes each of said plurality of band-limited image signals so as to suppress noise in said each pixel of each of said plurality of band-limited images based

on said at least one index value obtained for said each pixel of said each plurality of band-limited images (col. 9, line 59 col. 10, line 8, Vuylsteke teaches the noise suppression process is repeated for all detail images.).

Regarding claim 20, Vuylsteke discloses a method for suppressing noise in an input image signal representing a radiographic image (col. 1, lines 6-10), said method comprising the steps of:

(a) generating a plurality of band-limited image signals respectively representing a plurality of band-limited images belonging to a plurality of different frequency bands, based on said input image signal (col. 7, lines 9-13, 37- col. 8, line 3, Vuylsteke teaches a decomposing the input image using low pass filtering to create a plurality of detail images representing multiple resolution levels.);

(b) obtaining at least one index value indicating a degree of suppression of said noise (col. 9, lines 42-58, Vuylsteke teaches the noise suppression function Sv_n.), the at least one index value corresponding to a function based on information indicating an exposure dose with which said radiographic image has been produced (col. 9, lines 42-58; col. 1, lines 14-18; col. 8, lines 39-67, Vuylsteke teaches the noise suppression function is a function of local variance. Vuylsteke teaches the local variance of pixels and noise variance are computed for the image and that there is a well-known tradeoff between image quality and patient dose due to the presence of noise in the radiation source. As described in the specification (page 7, line 20 – page 8, line 3) pixel values of the radiographic image are information that can indicate exposure dose. The variances described by Vuylsteke are characteristics of the image and are functions of pixel values that are indicative of exposure dose.); and

(c) processing each of said plurality of band-limited image signals so as to suppress noise in each of said plurality of band-limited images based on said at least one index value (col. 6, lines 4-7; col. 3, line 61 – col. 4, line 17, lines 23-46; col. 10, lines 4-6, Vuylsteke teaches a performing smoothing/noise suppression on the different resolution level images.).

Regarding claim 21, Vuylsteke does not explicitly recite "a computer-readable storage medium storing a program which instructs a computer to execute a method." The apparatus Vuylsteke describes clearly performs computations on digital pixel values, has memory and can output a viewable image on a display screen (CRT) (col. 6, lines 1-13). This description of the processing apparatus clearly describes the elements and capabilities of a conventional computer, which inherently have computer-readable storage mediums (including, but not limited to RAM, ROM, Hard drives) in which programs are stored for execution by the computer.

Vuylsteke further discloses a method for suppressing noise in an input image signal representing a radiographic image (col. 1, lines 6-10), said method comprising the steps of:

(a) generating a plurality of band-limited image signals respectively representing a plurality of band-limited images belonging to a plurality of different frequency bands, based on said input image signal (col. 7, lines 9-13, 37- col. 8, line 3, Vuylsteke teaches a decomposing the input image using low pass filtering to create a plurality of detail images representing multiple resolution levels.);

(b) obtaining at least one index value indicating a degree of suppression of said noise (col. 9, lines 42-58, Vuylsteke teaches the noise suppression function Sv_n.), the at least one index value corresponding to a function based on information indicating an exposure dose with which said radiographic image has been produced (col. 9, lines 42-58; col. 1, lines 14-18; col. 8, lines

39-67, Vuylsteke teaches the noise suppression function is a function of local variance. Vuylsteke teaches the local variance of pixels and noise variance are computed for the image and that there is a well-known tradeoff between image quality and patient dose due to the presence of noise in the radiation source. As described in the specification (page 7, line 20 – page 8, line 3) pixel values of the radiographic image are information that can indicate exposure dose. The variances described by Vuylsteke are characteristics of the image and are functions of pixel values that are indicative of exposure dose.); and

(c) processing each of said plurality of band-limited image signals so as to suppress noise in each of said plurality of band-limited images based on said at least one index value (col. 6, lines 4-7; col. 3, line 61 – col. 4, line 17, lines 23-46; col. 10, lines 4-6, Vuylsteke teaches a performing smoothing/noise suppression on the different resolution level images.).

Regarding claims 37-41, Vuylsteke further discloses the function is defined by at least a signal value of a pixel and an amount of the exposure dose of the radiographic image (col. 1, lines 14-18; col. 8, lines 39-67, Vuylsteke teaches the local variance of pixels and noise variance are computed for the image and that there is a well known tradeoff between image quality and patient dose due to the presence of noise in the radiation source. As described in the specification (page 7, line 20 – page 8, line 3) pixel values of the radiographic image are information that can indicate exposure dose. The variances described by Vuylsteke are characteristics of the image and are functions of pixel values that are indicative of exposure dose.).

Claims 4 and 5 are rejected under 35 U.S.C. 103(a) as being unpatentable over Vuylsteke in view of USPN 6,173,084 to Aach et al. (hereafter "Aach").

Regarding claim 4, Vuylsteke further discloses said characteristic calculation unit obtains said at least one first characteristic of said input image signal based locally calculated from pixel values in a neighborhood of a pixel of interest in at least one of said plurality of band-limited images represented by at least one of said plurality of band-limited image signals (col. 8, lines 36-62, Vuylsteke teaches the local variance (first characteristic) is computed from an NXN neighborhood of pixel values around the current target pixel (pixel of interest) for each detail image.).

Vuylsteke is silent with regard to calculation of said at least one first characteristic of said input image signal based on second information. However, Aach teaches finding weighted averages of pixel values and the direction in which the neighboring pixel is located in the current detail image with respect to the pixel being filtered and calculating the magnitude of the difference between the pixels in said direction (col. 3, lines 22-35).

The teachings of Vuylsteke and Aach are combinable because they are both concerned with image processing to reduce noise in radiographic images. It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the apparatus taught by Vuylsteke having the first characteristic calculation be based on first information taught by Vuylsteke and second information taught by Aach in order to avoid blurring the image (col. 3, lines 64 – col. 4, line 4) and preserve edge structures (col. 4, lines 14-45).

Regarding claim 5, Aach further discloses an apparatus wherein said characteristic calculation unit obtains a pixel vector at said pixel of interest in said at least one of said plurality of band-limited images (col. 3, lines 22-35, Aach teaches that the weight factor is obtained by finding the direction of a neighboring pixel with respect the to pixel being filtered and

calculating the magnitude of the difference between the pixels in said direction (pixel vector).), and detects an orientation of an edge as said second information (col. 4, lines 14-31) Aach teaches how the weighting factors take into account the direction and magnitude of gradients and how they indicate an edge), and

said smoothing unit arranges said at least one second characteristic of said smoothing filter so that said radiographic image is smoothed along said orientation of said edge (col. 4, line 14-45, Aach teaches the weighting factors are appropriately calculated according to gradient directions in order to preserve edge structures.).

Claim 6 is rejected under 35 U.S.C. 103(a) as being unpatentable over Vuylsteke in view of USPN 5,351,305 to Wood et al. (hereafter "Wood").

Regarding claim 6, Vuylsteke does not disclose said smoothing filter includes for each of a plurality of predetermined directions a plurality of filters respectively smoothing said radiographic image in said plurality of predetermined directions to a plurality of different degrees, and

said smoothing unit adapts said at least one second characteristic of said smoothing filter to said input image signal by selecting one of said plurality of filters based on said at least one first characteristic of said input image signal.

However, Wood discloses a smoothing filter that includes a plurality of filters at predetermined directions (col. 5, lines 7-13, Wood also teaches that the filters are at 10 degree increments), and that the smoothing filter selects one of the plurality of filters based on at least one characteristic of the input image signal (col. 4, lines 61-68, Wood teaches comparing the

angle of the edge with the preselected array of directions corresponding to the directions of preselected directional filters.).

The teachings of Vuylsteke and Wood are combinable because they are both in the same field of endeavor, namely smoothing and noise reduction in medical imaging. It would have been obvious to on of ordinary skill in the art at the time the invention was made to modify the apparatus (namely the smoothing unit) of Vuylsteke to include a plurality of directional filters which the smoothing unit selects based on the input image signal as taught by Wood in order to produce better quality images which are smooth across regions of homogeneity while preserving edges regardless of their size or direction. By smoothing along the direction of the edges, the boundaries of image regions are not compromised (Wood, col. 2, line 66 – col. 3, line 3.).

(10) Response to Argument

Appellant argues "Vuylsteke does not disclose or suggest the claimed characteristic calculation unit which obtains at least one first characteristic of the input image signal by calculation using a function based on first information indicating an exposure dose, as set forth in claim 1." (page 19, lines 1-5).

Examiner respectfully disagrees. Examiner refers to Figure 4a of Vuylsteke (shown below) and its corresponding text (col. 7, line 37- col. 8, line 8).

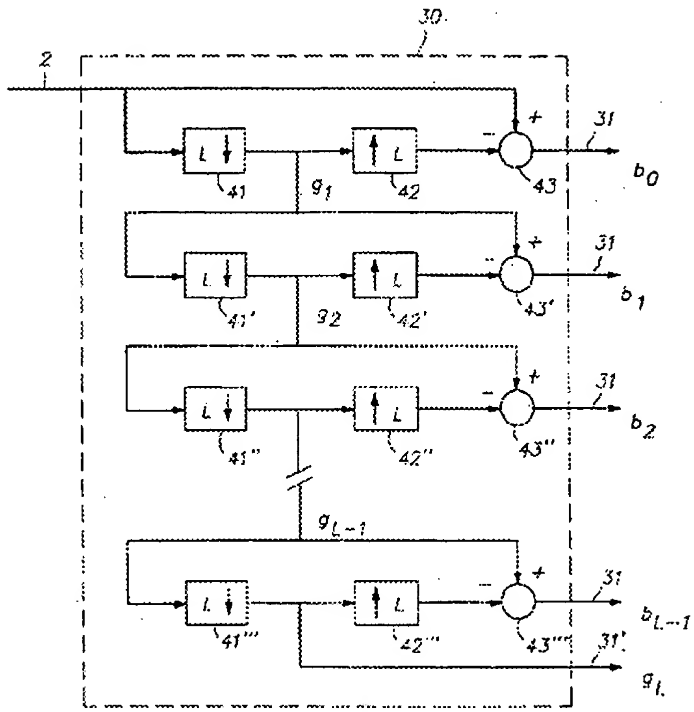

FIG. 4a

The original image 2 is decomposed into a sequence detail images 31 and a low-resolution approximation 31'. As described in the specification of the present invention (page 7, line 20 – page 8, line 3), pixel values of the radiographic image are information that can indicate exposure dose. Therefore, pixel values of the original image 2 are indicative of exposure dose and correspond to the **first information indicating an exposure dose with which said radiographic image has been produced** as presently recited in claim 1. Examiner notes that detail images 31 are reasonably construed as being obtained using <u>functions</u> applied to the original image 2.

Examiner now refers to Figure 5 (shown below) of Vuylsteke and its corresponding text (col. 8, lines 36-67).

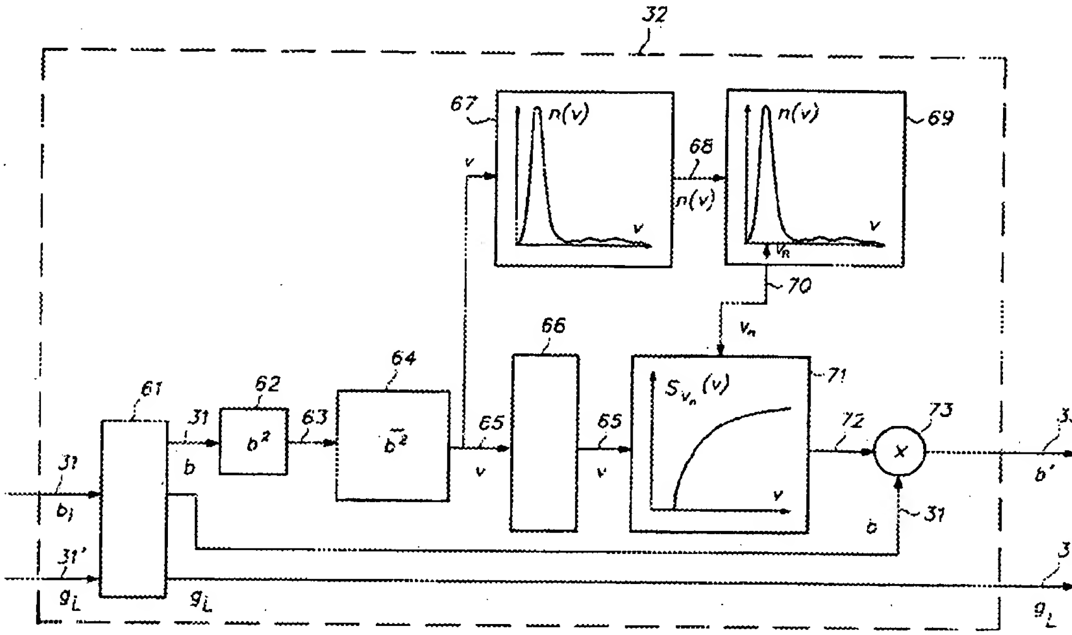

FIG. 5

The detail image 31 is input into memory 61, squared in unit 62, and the local variance v is computed in unit 64. The obtained local variance is obtained using <u>functions</u> applied to the detail image 31. Histogram computation unit 67 determines a histogram of the local variances v and maximum locator 69 determines the estimate for noise variance Vn 70. From this description it is clear noise variance Vn is clearly obtained using <u>functions</u> applied to detail image bi 31, which is itself obtained using <u>functions</u> applied to the original image 2, the pixels of the original image 2 being indicative of the exposure dose. Therefore the calculation units illustrated in Figures 4a and 5 and described above clearly read on the limitation of **a characteristic calculation unit which obtains at least one first characteristic of said input image signal by calculation using a function based on first information indicating an exposure dose with which said radiographic image has been produced** as presently recited in claim 1, the noise

variance Vn 70 corresponding to the first characteristic and the pixels of the original image 2 corresponding to the first information indicating exposure dose.

Appellant further argues details of the Vuylsteke reference which are not found in the claims. Appellant is reading Vuylsteke differently than how the Examiner is broadly interpreting the claims. For example, Appellant argues "Vuylsteke merely discloses the use of a histogram of the squared neighborhood average v of the difference images bi to calculate the noise variance Vn corresponding to a difference image representing a certain frequency band as a single value. Because the squared neighborhood averages v of the difference images bi depend on the edge signal amount and the noise amount of the original image, the shape of the histogram is directly dependent on the edge signals and the noise in the image. Therefore, the shape of the histogram of an image including a large amount of noise will be different from the shape of a histogram of an image with small amount of noise. Accordingly, the shape of the histogram does not reflect the amount of exposure dose. This is because the difference image bi is created by subtracting a smoothed image from the original image as described above, the pixel value of a difference image bi does <u>not</u> depend on an exposure dose." (page 18, lines 4-14). Appellant further argues that "the processing disclosed in Vuylsteke, which depends on a value, i.e., noise variance Vn, calculated based on the original image does not disclose or suggest the claimed calculation using a function based on first information indicating an exposure dose." (page 18, lines 17-20).

The Examiner is interpreting Vuylsteke in the following manner. The detail image (difference image) bi 31 is a function of the original image 2, the pixels of the original image 2

being indicative of the exposure dose. Next, the noise variance Vn 70 is selected as the highest occurrence in a histogram of local variances calculated from the detail image bi 31, thus Vn 70 can be construed as a function of detail image bi 31, which is itself a obtained using function applied to original radiographic image 2. Thus the noise variance Vn 70 is also a function of the original radiographic image 2, the pixels of the original radiographic image 2 being indicative of the exposure dose as supported by the disclosure of the present invention (page 7, line 20 – page 8, line 3). Examiner notes column 1, lines 16-18 of Vuylsteke reciting, "there exists a well known tradeoff between diagnostic image quality and patient dose, due to the presence of noise in the radiation source." Appellant's discussion of the relationship between the shape of the histogram and its dependency on the noise in the image (page 18, lines 8-11) and this teaching of Vuylsteke further supports relationship between the noise present in an image and the exposure dose, clearly suggesting the noise variance Vn is in someway dependent on the exposure dose. Given the broadest reasonable interpretation of the claim language, the Vuylsteke reference clearly reads on all the limitations recited in claim 1. Specifically, **a characteristic calculation unit which obtains at least one first characteristic of said input image signal by calculation using a function based on first information indicating an exposure dose with which said radiographic image has been produced.**

Regarding claims 7-11, 20 and 21, the Examiner has clearly shown the Vuylsteke reference is not deficient in its teachings of the limitations of claim 1 as presently recited. As claims 7-11, 20 and 21 similarly recite the limitations at issue, arguments analogous to those presented above for claim 1 are applicable to these claims as well.

Regarding dependent claims 2-6, 12, 13 and 37-41, the Examiner has clearly shown the Vuylsteke reference is not deficient in its teachings of the limitations of claim 1 and analogous claims 7-11, 20 and 21 as presently recited. As Appellant has not addressed any further issues with regard to these dependent claims, Examiner has concluded Vuylsteke alone and its combinations with Aach and Wood sufficiently disclose the additional limitations presented by these dependent claims.

(11) Related Proceeding(s) Appendix

No decision rendered by a court or the Board is identified by the examiner in the Related Appeals and Interferences section of this examiner's answer.

For the above reasons, it is believed that the rejections should be sustained.

Respectfully submitted,

Anthony Mackowey

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